The Occurrence of Earth-Like Planets Around Other Stars

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The quantity $\eta_\oplus$, the number density of planets per star per logarithmic planetary radius per logarithmic orbital period, describes the occurrence of Earth-like extrasolar planets. Measurement of $\eta_\oplus$ is complicated by the difficulty of detecting Earth-like planets in Earth-like orbits about Sun-like stars; previous estimates[1–5] place $1\% \lesssim \eta_\oplus \lesssim 34\%$. Here we present constraints on $\eta_\oplus$ from a parameterised forward model of the (correlated) period-radius distribution and the observational selection function in the most recent (Q17) data release from the Kepler satellite[6–8]. We parameterise the intrinsic distribution of planetary periods and radii using a single, correlated Gaussian component; treat selection effects using a parameterised transit detection probability based on the measured noise level and stellar properties in the Kepler catalog; and include an empirically-parameterised, independent component in the planet period-radius distribution to represent false-positive planet detections. We find $\eta_\oplus = 4.1^{+2.3}_{-1.7}\%$ (90% CL). Additionally, we find that each star hosts $4.04^{+0.85}_{-0.68}$ planets with $P \lesssim 3\mathrm{yr}$ and $R \gtrsim 0.2R_\oplus$ and that the peak of the planet radius distribution lies at $R_\mathrm{peak} = 1.19^{+0.17}_{-0.18}R_\oplus$ (all 90% CL). Our empirical model for false-positive contamination is consistent with the dominant source being backgroud eclipsing binary stars, with $1.1^{+0.2}_{-0.18} \times 10^{-3}$ false-positives per star. Will: More science stuff here.

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